Western Electric Co., Inc.,
Engineering Dept.
New York.

Appendix 2
Issue 1 - BT-501158
September 18, 1922.

METHOD OF OPERATION
SCHEMATIC
For -- Automatic Routine Test of Final Selectors -- Automatic Routine Selector Test Frame -- Power Driven Machine Switching System.

Under Detailed Description add the following to paragraph 60.

In figure 2 are shown two alarm circuits, one a busy time alarm and the other a trouble time alarm. The busy time alarm is arranged to cover the movement of the test circuit from the time of pressing the start key until the final selector to be tested has been found free and seized by the test circuit. The trouble time alarm is arranged to cover each single test from the time the final selector is seized until the R-4 switch advances beyond position 18. "A" wiring is used when the time period for a single test is to be as short as possible and "B" wiring is used when it is desired to have the time period of longer duration.

Under Circuit Requirements change the designation for the B36 relay from (10) to (TL) and for the E428 relay from (Z) to (ZC).

Under the E528 relay add the designation (TR) and under the E596 relay add the designations (TA), (TBL) and (BY).

Add the requirements for the E1530 relay (VT) and (TBL-1) the requirements of which are as follows:-

CIRCUIT REQUIREMENTS

THE READJUST REQUIREMENTS SHOWN BELOW ARE FOR MAINTENANCE USE ONLY

	OPERATE	NON-OPERATE	RELEASE
E1530 (TBL-1) (VT).	Readj. .010 amp. Test .016 amp.	Readj. .0066 amp. Test .0062 amp.	

ENG.--JLS-VL CHK'D.--WCD-CWP. APPROVED - J.L. DON, G.M.L.

MT
E-1308

Western Electric Co., Incorporated,
Engineering Department,
New York.

Appendix No. 1.
Issue 1 - BT-501158.
May 17, 1922.

METHOD OF OPERATION
TEST CIRCUIT

For Automatic Routine Test of Final Selectors - Automatic Routine Selector Test Frame - Full Mechanical Power Driven System.

In paragraph 51, the second sentence shall be replaced by the following:

"When the brush assembly of the 1-A switch rests upon terminal 21, the ACA relay operates through its primary winding. The ACA relay operated: (a) locks up under control of the CON relay, and (b) operates the TRA relay."

The circuit requirements for the E573 and E652 relays shall be omitted, and the circuit requirements for the E1530, E1230 and E703 relays shall be added.

CIRCUIT REQUIREMENTS

THE READJUST REQUIREMENTS SHOWN BELOW ARE FOR MAINTENANCE USE ONLY

		OPERATE	NON-OPERATE	RELEASE
E703 (ACA)	Test requirement of inner winding is proportional to test requirement of outer winding.			
Inner Wdg.	Readj.	.016 amp.		Readj. .002 amp.
	Test	.020 amp.		Test .001 amp.
Outer Wdg.	Readj.	.018 amp.		
	Test	.023 amp.		
E1230 (CON)	Readj.	.016 amp.	Readj. .009 amp.	
	Test	.019 amp.	Test .0085 amp.	
E1530 (VT)	Readj.	.010 amp.	Readj. .0066 amp.	
	Test	.016 amp.	Test .0062 amp.	

The circuit requirements for the following relays have been changed as shown:-

MECHANICAL REQUIREMENTS

207-A (STP)
(a) Unoperated air gap shall be .013" ± .001".
(b) Contact separation shall be minimum .004", maximum .005".

ELECTRICAL REQUIREMENTS

Special requirements to insure fast operation.

Readj.	.0105 amp.	Readj. .0095 amp.
Test	.011 amp.	Test .009 amp.

CIRCUIT REQUIREMENTS

THE READJUST REQUIREMENTS SHOWN BELOW ARE FOR MAINTENANCE USE ONLY

MECHANICAL REQUIREMENTS

208-B Prime counting relays (1' to 9')

(a) Armature gap-.015" ± .002".
(b) Contact gap - min. .004", max. .007".
(c) The retractile spring tension shall be adjusted by bending the stationary lug on the relay frame and not by bending the lug on the armature. In making this adjustment, the stationary lug shall not be bent to an angle greater than 45 degrees from the vertical.

ELECTRICAL REQUIREMENTS

OPERATE		NON-OPERATE		RELEASE
Special requirements to insure fast operation.				
Readj.	.015 amp.	Readj.	.014 amp.	
Test	.016 amp.	Test	.013 amp.	

MECHANICAL REQUIREMENTS

208-C (BO' and FO')

(a) Armature gap .015" ± .002"
(b) Contact gap - min. .004", max. .007".
(c) The retractile spring tension shall be adjusted by bending the stationary lug on the relay frame and not by bending the lug on the armature. In making this adjustment, the stationary lug shall not be bent to an angle greater than 45 degrees from the vertical.

ELECTRICAL REQUIREMENTS

Special requirements to insure fast operation.			
Through relay winding.		Through relay winding.	
Readj.	.012 amp.	Readj.	.011 amp.
Through parallel combination		Through parallel combination.	
Readj.	.024 amp.	Readj.	.022 amp.
Test	.025 amp.	Test	.021 amp.

MECHANICAL REQUIREMENTS

208-G counting relays (1 to 9 and 30)

(a) Armature gap .015" ± .002".
(b) Contact gap - min. .004", max. .007".
(c) The retractile spring tension shall be adjusted by bending the the stationary lug on the relay frame and not by bending the lug on the armature. In making this adjustment, the stationary lug shall not be bent to an angle greater than 45 degrees from the vertical.

CIRCUIT REQUIREMENTS

THE READJUST REQUIREMENES SHOWN BELOW ARE FOR MAINTENANCE USE ONLY

	OPERATE	NON-OPERATE	RELEASE

ELECTRICAL REQUIREMENTS

208-G (Cont'd)	Special requirements to insure fast operation.			
	Readj.	.015 amp.	Readj.	.014 amp.
	Test	.016 amp.	Test	.013 amp.
E547 (TI) Outer Wdg. (400 ohms)	Special requirements to insure fast operation.			
	Readj.	.048 amp.	Readj.	.039 amp.
	Test	.051 amp.	Test	.037 amp.
Inner Wdg. (900 ohms)	Test	.016 amp.		
E1192 (RS-1) Outer Wdg. (500 ohms)	Special requirements to insure marginal conditions.			
	Readj.	.064 amp.	Readj.	.046 amp.
	Test	.068 amp.	Test	.043 amp.
Inner Wdg. (500 ohms)	Through parallel combination.			
	Test	.045 amp.		
E1194 (TF) Inner Wdg. (1000 ohms)	Special requirements to insure fast operation.			
	Readj.	.024 amp.	Readj.	.016 amp.
	Test	.026 amp.	Test	.015 amp.
Outer Wdg. (800 ohms)	Test	.027 amp.		

ENG.--WLK-BH.
11-22-22.

CHK'D.--WAL-JVP.

APPROVED - C. L. SLUYTER, G.M.L.

Western Electric Co., Incorporated,
Engineering Department,
New York.

Issue 1 - BT-501158.
July 23, 1921.

METHOD OF OPERATION
TEST CIRCUIT
For Automatic Routine Test of Final Selectors - Automatic Routine Selector Test Frame - Full Mechanical Power Driven System.

GENERAL DESCRIPTION

1. This circuit is designed to test automatically the final selector circuits in a full mechanical office. The test of the final selector circuit consists in making a particular selection in the final multiple, thereby using all the apparatus incorporated in the selector circuit and of returning the final selector and sequence switch to normal upon a successful conclusion of the test. Since the test will not proceed in case of trouble in the test circuit itself or in the final selector circuit under test, the successful test of a final circuit is used as an O.K. signal to advance the test to the next final selector circuit. This circuit makes use of either local or inter-office incoming selectors, the elevators of which are controlled by the test circuit to obtain access to the various final circuits to be tested. When not being used for test purposes, the local incoming selectors are used in regular traffic. However, only particular circuits are used for testing purposes in the case of inter-office selectors. When used for test purposes, the incoming selector sequence switches do not move out of position 1, the elevators only being used. The movement of the elevator is controlled by the test circuit causing it to test the proper group of final circuits. The circuit is arranged to test only adjacent groups of final selector circuits in an incoming bank. From one to four groups of final selectors on the same bank may be tested each time the incoming elevator is set up. When non-adjacent groups of final selector circuits are to be tested, the incoming selector has to be sent up as many times as there are sets of groups to be tested. The cross connection of the I switch together with the associated terminal strips, determine the number of times an elevator must be sent up to complete the test of all groups in a frame.

2. The operation of two keys causes the circuit to automatically test all final selector circuits, even if they are not arranged in adjacent groups. The particular test that is made is dependent upon the position of a sequence switch in the test circuit. The test circuit proceeds from frame to frame as may be required. The circuit is arranged to permit an elevator to pass over intermediate overflow terminals and only be returned to normal when the final overflow terminals of a series of groups have been reached. Should the test circuit find the particular incoming elevator, which it is to use, busy, it will wait until the elevator is restored to normal before proceeding with the test. In the case of a busy final selector circuit, the test circuit holds up the test for a reasonable length of time, until the selector is restored to normal. Should either of the selector circuits not be restored to normal within a reasonable length of time a lamp lights and an alarm bell rings. These alarms may also be operated in case of trouble arising in either the test circuit or the final selector. The alarm operates also in case insufficient time is left after the busy final selector has been discharged to complete the routine test. The circuit is provided with registers which count the actual number of single tests made as well as the number of multiple tests made.

3. The circuit is provided with special keys, which when operated cause the circuit to make an automatic test of a particular group or groups of final selectors, that is, any group or series of groups of final selector circuits in any frame may be chosen as well.

Start Key (ST).

4. The operation of this key and the TRA key, starts the automatic final test which continues until all final circuits have been tested. If other keys are operated, the operation of this key starts the special test as determined by the keys operated. The release of the key at any time will stop the test.

Transfer Key (TRA).

5. The transfer key is a two way type key. When normal the terminals of line 99 in the final frame are connected thru to the intercepting operator's position. Should a calling subscriber intentionally or accidentially reach the terminals of line 99 the call will be routed to the intercepting operator. When the key is operated in one direction the terminals of line 99 are connected to a jack box of the final frame for manual testing. When the key is operated in the opposite direction the terminals of line 99 are connected back into the test circuit for automatic testing.

Return to normal key (RN).

6. The operation of this key causes the incoming selector switches (1-A, 1-B, etc.) to return to normal, but it is not effective unless the ST key has been restored to normal and the test advanced to a point where the circuit under test will not be left unguarded.

Control advance key (CA).

7. This key is operated when either the test circuit fails to complete a cycle due to a fault in itself, or in the circuit under test. The operation of the key advances the control circuit, but the circuit does not resume the test until the key is restored to normal. When the key is restored, the circuit will advance to the next test if the repeat key is not operated. The key should not be restored when a final circuit is to be made busy until the final has actually been made busy. In the case of a repeat test this key should not be restored until the final circuit under test has been restored to normal.

Repeat key (REP).

8. The operation of the repeat key causes the test circuit to repeat on the final circuit under test until the key is released. A single repeat test is made by momentarily operating the key.

Automatic pass-by key (APB).

9. The operation of this key causes the test circuit to automatically pass all terminals that are busy.

Manual Pass-by key (MPB).

10. The operation of this key steps the incoming elevator from a busy final terminal to the next terminal which may or may not be busy. The test does not proceed until the key is restored to normal.

End of cycle key (EC)

11. The operation of this key at the end of one completed cycle causes the test circuit to start another cycle of tests.

Particular circuit key (PC).

12. The operation of this key in combination with other keys enumerated below, causes the apparatus to make a test upon a particular group or groups of final circuits. The actual test does not proceed until the release of the key.

Multi-test key (MT).

13. The operation of this key causes seven different tests to be made on each final circuit. When normal, only one test is made on each final circuit. The one test which is made depends upon the position of a sequence switch in the test circuit. This switch is set manually to the position of the desired test when the MT key is normal.

14. For testing a particular group or groups of final circuits this circuit is provided with units keys (0 to 9 inclusive:) A tens (T) key, which adds ten to the particular U key depressed: one or more twenty (TWA,TWB,TWC) keys, each of which controls a particular incoming selective switch; group number (GN) keys (0 to 3 inclusive) to drive the incoming elevator to the particular group to be tested; and overflow count (OC) keys (0 to 3 inclusive) which determine the number of overflow terminals to be passed before the selector is restored to normal.

15. As mentioned under paragraph 13, the type of test made on the final selector depends upon the position of the R-3 sequence switch in the test circuit. The following table shows the position of this sequence switch for any particular type of test together with the number and the final frame to which the final selector is driven.

Position of R-3 Sequence Switch	Number to which Final is Directed	Conditions imposed on line.
1	99	Individual line idle
3	99	" " busy
5	99	P.B.X. Line idle (first of group)
7	97	Hunt idle PBX line (last of group)
9	97	Hunt busy PBX " (last of group)

Position of R-3 Sequence Switch	Number to which Final is Directed	Conditions imposed on line.
11	97	Hunt idle PBX line (intermediate)
13	99	"No test feature" test.

DETAILED DESCRIPTION

Routine Test.

15. An automatic test is started upon all final selector circuits with the operation of the ST and TRA relay. The ST key operated, closes a circuit from ground through the contacts of the key, upper contacts of cam O on connector 1, and upper contacts of all O cams of the other connectors (if all connectors are normal) to battery through the winding of the ST relay which operates. The ST relay operated, hold to ground over the same circuit and closes a circuit from ground through the make contact of the TRA key, make contact of the ST relay, break contact of the EC key, normal contacts of the "TW" keys, N terminal and brush 1 of the 1-A1 switch, break contact of the TRA relay, to battery through the break contact and windings of the 200-M (1-A) selector magnet, energizing the magnet. Ground is also connected through the make contact of the ST relay to the winding of the T relay but the T relay does not operate at this time on account of ground being connected to the other side of the winding through brush 1 of the 1-A1 switch. The energized selector magnet opens its operating circuit and releases, stepping the brush of the I-A switch to terminal 1. If this terminal is wired for a final test, ground will not be connected to it and the T relay will operate in a circuit from ground through the make contact of the TRA key, make contact of the ST relay, lower contacts of the cam J, winding of the T relay, break contact of the TRA relay to battery through the contact and winding of the 200-M (1-A) selector magnet. The selector magnet does not operate in series with the T relay on account of the high resistance. If terminal 1 of I-A-I switch is not wired for a test, ground is connected to that terminal, causing the associated 200-M selector magnet to energize and step the brush to the next terminal to which no ground is connected. The operation of the T relay, closes a circuit from ground through its make contact to battery through the winding of the CON relay, which operates and locks to ground through its make contact and make contact of the ST key. The operation of the CON relay closes a circuit from ground through its make contact break contact of the EC key, brush and terminal 1 of the I-A6 switch, cross connection of the terminal strip 6, over lead 1, lower contacts of cam P of the last connector switch in the equipment of the circuit, lower inner contact of cam B (R-IA) to battery through the R-IA magnet, advancing the switch to position 2.

16.1 NOTE: When more than one connector is required to test all the incoming selector circuits in an exchange, each succeeding connector cannot be moved out of normal until the preceding connector used has been restored to its normal position. For instance, if it is assumed that the second connector shown on the schematic is the last of a series of connector units, connector 1 can only be moved out of position 1 or 10, after the last connector is restored to position 1

or 10. The circuit for restoring the last connector, or any preceding connector to the one required for the test, is from ground through the make contact of the CON. relay, brush 6 and some terminal of an I switch, cross-connection of the associated terminal strip 6, lower inner and upper outer contacts of cam P of the last connector unit used, lower inner contact of the cam C of the connector, to battery through the R magnet of the connector, advancing the connector unit to position 1 or 10. If one of the connector units does not return to normal, the circuit ceases to function and operates the alarm as hereinafter described.

BUSY TEST OF INCOMING SELECTOR

17. With the R-IA switch in position 2, a circuit is closed from ground through the 400 ohm winding of the TI relay, upper outer and lower inner contacts of cam K on the B-62 switch lower contacts of cam R (R-IA) cross connection of terminal strip 5, terminal 1 and brush of the I-A-5 switch, make contact of the T relay to battery through the 18-AJ resistance, operating the TI relay. The operation of the TI relay closes a circuit from ground through its make contact, lower outer contact of cam C, to battery through the R-2 magnet, advancing the B-62 sequence switch to position 2. With the R-IA and R-2 switches in position 2, the incoming selector circuit assigned for test purposes is tested by the automatic test circuit to find whether it is busy on routine service. As long as the incoming selector circuit is busy, the TI relay is held operated over a circuit from battery through the make contact of the T relay, brush 5 and terminal 1 of the I-A switch, cross connection of terminal strip 5, lead 1, lower contacts of cam R, (a) to ground through the break contact of the BIS relay and 400 ohm winding of the TI relay (b) to ground through the 900 ohm winding and make contact of the TI relay, lower contacts of cam N to ground in the incoming circuit over the TK-1 lead. When the incoming circuit becomes idle and the incoming selector returns to normal, ground is removed from the TK-1 lead and the BIS relay operates from battery on the make contact of the T relay to ground over the TY-1 lead through the Y commutator brush and segment in the incoming circuit, releasing the TI relay. The function of the BIS relay is to hold the TI relay operated through its 400 ohm winding in case ground is removed from the TK-1 lead due to the unguarded period on a local incoming selector circuit after it has been released by the district and before the elevator is restored to normal. The release of the TI relay under these conditions would cause the test circuit to seize the selector before it is restored to normal, causing current to be applied to the UP magnet by the test circuit at the same time current is applied to the DOWN magnet by the local selector circuit. The operating circuit of the TI relay through its 400 ohm winding is opened when the R-2 switch advances out of position 1-1/2. The release of the TI relay closes a circuit from ground on the lower inner contact of cam F, break contact of the TI relay, lower contacts of cam N (R-IA) to the TK-1 lead holding the incoming busy to other hunting incoming selectors, and also closes a circuit from ground through its break contact, upper outer contact of cam C, to battery through the R-2 magnet, advancing the switch to position 3.

SETTING INCOMING CONTROL SWITCH

18. With the R-2 switch in position 3, a circuit is closed from ground through the inner contacts of cam E, to battery through the break contact and winding of the 200-L selector magnet and 44-A resistance energizing the magnet. The operation of the magnet opens its energizing circuit, causing it to release and step the brushes of the IC switch to terminal 1 or other odd numbered terminals depending upon the cross connection of terminal strip 4.

19. With the scheme of cross connection shown on the drawing and with the brushes of the I-A switch resting on terminal 1, groups 0 to 3 inclusive in the first frame are tested. The 200-L selector continues to step until the winding of the selector magnet is shunted by ground over one of the leads connected to bank 2 of the IC switch. As determined by the cross connection of the I-A switch and terminal strip 4, the 200-L selector magnet is shunted when its brush assembly rests on terminal 1. This circuit is from ground through the normal contacts of the PC key, brush 4 and terminal 1 of the I-A switch, cross connection of terminal strip 4, over lead 4 to terminal 1 and brush 2 of the IC switch, and inner contacts of cam O, to battery through the 44-A resistance. The position of the IC switch determines the number of overflow terminals the incoming elevator must pass by before it is restored to normal. With the setting just made, the incoming elevator returns to normal when the elevator brushes have stepped to the 4th set of overflow terminals.

20. Also with the R-2 witch in position 3, a circuit is closed from ground through the upper inner contact of cam G to battery through the RS-2 relay, which operates. (See paragraph 64 for explanation of slow release feature). The operation of the RS-2 relay closes a circuit operating the TF relay through its 1000 ohm winding, and advances the R-2 switch to position 4 over circuit from ground through the break contact of the O' relay lower contacts of cam Q on the B-62 switch, make contact of the RS-2 relay, lower contacts of cam D to battery through the R-2 magnet. The TF relay operated in turn operates the TF-1 relay over a circuit from ground through the armature and break contact of the Z relay, brush 5 and terminal 1 of the IC switch, make contact of the TF relay to battery through the winding of the TF relay. The TF and TF-1 relays operated perform no useful function at this time.

INCOMING BRUSH SELECTION

21. The incoming brush selection is determined by the cross connection of terminal strip 2. With the scheme used in the schematic and with the I-A switch resting on terminal 1, the O brush on the first incoming elevator is selected. In position 4 of the R-2 switch, a circuit is closed from ground through the upper outer contact of cam H (R-2), lower outer contact of cam C (R-1A), to battery through the R-1-A magnet, advancing the switch to position 3. In position 3, connector 1 is connected through the cuttings of its cams to the incoming elevator which is held busy to other hunting incoming selectors by ground through the break contact of the PG relay, and inner contacts of cam Q (R-IA) to the TK-1 lead. Also in position 3 a circuit is closed from ground through the break contact of the O' relay, lower contacts of cam Q

on B62, make contact of the RS-2 relay, inner contacts of cam D on the B62 switch, lower contacts of cam J (R-IA) over the lead TU-1, to battery through the UP magnet in the incoming selector circuit. As the incoming elevator moves up under control of the UP magnet, ground is connected through the A commutator brush and segment, over lead TA-1, lower contacts of cam M (R-IA), outer contacts of cam N (R-2), brush 2 and terminal 1 of the 1-A switch, cross connection of terminal strip 2, to lead O, then to battery through the winding of the O relay, and contacts of cam R operating the O relay. The operation of the O relay connects its winding in series with the winding of the O' relay, but the O' relay does not operate as it is shunted at this time by ground. When the brush on the incoming elevator makes contact with an insulated segment on the A commutator bar, ground is removed from one side of the O' counting relay, allowing it to operate. The O' relay operated, closes a circuit from ground through its make contact, lower inner contact of cam C (R-2) to battery through the R-2 magnet, advancing the switch to position 5. The operation of the O' relay disconnects ground from the TU-1 lead, stopping the up-drive of the incoming selector. When the R-2 switch advances out of position 4-1/4, the operating circuit for the O' and O relays is opened at cam R, releasing the relays. When the R-2 switch advances out of position 4, the circuit over the TU-1 lead is opened at the upper contact of cam D, preventing the UP magnet in the incoming selector circuit from operating to ground on the break contact of the O' relay. With the R-2 switch in position 5, a circuit is closed from ground through the upper outer contact of cam F, lower contacts of cam I (R-IA) over the TM-1 lead to battery through the TRIP magnet in the incoming circuit, energizing the magnet. Also with the R-2 switch in position 5, a circuit is closed from ground through the break contact of the O' relay, lower contacts of cam Q, make contact of the RS-2 relay, lower contacts of cam D, to battery through the R-2 magnet advancing the switch to position 6.

INCOMING GROUP SELECTION R-IA Rev. 3

22. With the R-2 switch in position 6, a circuit is closed from ground through the break contact of the O' relay, lower contacts of cam Q, make contact of the RS-2 relay, inner contacts of cam D, lower contacts of cam J (B-IA) over the TU-1 lead, to battery through the UP magnet in the associated incoming circuit, moving the selector up for group selection. As the district elevator moves upward under control of the UP magnet, intermittent ground from the B commutator brush and segment in the district circuit is connected over the TB-1 lead through the lower contacts of cam L (R-IA) upper contacts of cam M (R-2) normal contacts of the PC key, brush 3 and terminal 1 of the 1-A switch, cross-connection of terminal strip 3, lead O, to battery through the winding of the O relay and contacts of cam R (R-2), operating the O relay. The O relay operated connects its winding in series with the winding of the O' relay, which does not operate at this time. When the B brush of the incoming elevator makes contact with an insulated segment of the commutator, ground is removed from one side of the O' relay, allowing it to operate. The O' relay operated: (a) opens the circuit through the UP magnet in the incoming selector circuit, stopping the movement of the elevator, and (b) advances the R-2 switch to position 7, over a circuit from ground through the make contact of the O' relay, normal contact of the PC key, upper inner contact of cam B, to battery through the R-2 magnet. As the switch advances out of position 6-1/4, the operating circuit of the O and O' relays is opened at cam R, releasing the relays.

BUSY TEST OF FINAL CIRCUIT.

23. When the R-2 switch advances out of position 6, the operating circuits for the RS-2 and T relays are opened at cams G and J respectively, releasing the relays. The release of the RS-2 relay opens the holding circuit through the 1000 ohm winding of the TF relay. When the final selector circuit is busy, the TF relay is now held operated from battery through its 800 ohm winding, break contacts of the APB and MPB keys, make contact of the TF relay, break contact of the CA key, break contacts of the TKR and NT relays, lower contacts of cam D (R-1A) over the TS-1 lead to ground on the sleeve terminal of the busy final selector circuit. With the TF relay held operated, the TF-1 relay is held operated over a circuit from battery through the winding of the TF-1 relay, make contact of the TF relay, terminal 1 and brush 5 of the IC switch, to ground through the break contact of the Z relay. If the final circuit is idle, or becomes idle, the holding circuit for the TF relay is opened, releasing the TF relay. The TF-1 relay is still held operated from battery through its make contact to ground through the break contact of the RS-3 relay and upper outer contact of cam G. The release of the TF relay operates the TR relay over a circuit from ground through the break contact of the Z relay, brush 5 and terminal 1 of the IC switch, break contact of the TF relay, make contact of the TF-1 relay, break contact of the MPB key, to battery through the winding of the TR relay. The operation of the TR relay connects the TT-1 and TR-1 leads through its make contacts to the test circuit, and closes a circuit from ground through its make contact, outer contacts of cam F on the A-57 switch, lower outer contact of cam B (R-4) to battery through the R-4 magnet, advancing the switch to position 2. The operation of the TR relay also closes a circuit from ground in the final, over the TR-1 lead, make contact of the TR relay, inner contacts of cam I (R-4) outer contacts of cam L (R-3) to battery through the winding of the VT relay, operating the VT relay which closes the tip side of the final to allow selection to proceed. The final circuit is held busy to other hunting incoming selectors by ground through the upper outer contact of cam E (R-2) break contact of the TF relay, break contact of the CA key, break contacts of the TKR and NT relays, and lower contacts of cam D (R-1A) over the TS-1 lead.

FINAL BRUSH SELECTION

24. In position 2 of the B-63 switch, the particular final brush which is designated to test the final multiple for an auxiliary test circuit is selected. The STP relay operates in a circuit from battery through a winding of the L relay in the final circuit, over the TT-1 lead, lower contacts of cam F (R-1A) make contact of the TR relay, make contact of the VT relay, 18-BK resistance, lower contacts of cam K, break contact of the BO relay, winding of the STP relay, to ground.

25. As the final elevator moves upward, intermittent ground is connected through the A commutator brush and segment over the TT-1 lead, successively short circuiting the STP relay, thus releasing and permitting its re-operation until the proper group has been selected. For test purposes, brush 4 and group 9 have been assigned requiring five and ten pulses, respectively, to

satisfy the sender portion of the test circuit. With the R-4 switch in position 2, a circuit is closed from ground through the inner contacts of cam R, make contact of the STP relay, lower inner and upper outer contacts of cam S, lower contacts of cam Q, break contact of the 4' counting relay, winding of the 4 counting relay, lower contacts of cam N, to battery on cam T, operating the 4 counting relay. The operation of the 4 counting relay connects its winding in series with the 4' counting relay, which operates when the A commutator brush of the final selector makes contact with a grounded segment of the A commutator. When this occurs, the STP relay releases, removing ground from one side of the 4' counting relay, allowing it to operate and look in a circuit through the make contact of 4 counting relay to ground. The operation of the 4' counting relay transfers the pulsing circuit to the 3 counting relay through the make contact of the 4' relay and break contact of the 3' counting relay, causing the 3 counting relay to operate. Upon the next pulse transmitted by the A commutator brush and segment, the 3' counting relay operates and locks to ground. In a similar manner, the 2 and 1 sets of counting relays operate and lock on the third and fourth pulses respectively, and the SO relay on the fifth pulse. When the STP relay releases on the fifth impulse both the FO' and BO' relays operate in parallel and in series with the SO relay and lock to ground through the make contact and armature of the SO relay. The operation of the BO' relay opens the fundamental circuit, thus stopping the upward movement of the final selector. The operation of the FO' relay closes a circuit from ground through its make contact, cam Z, to battery through the R-4 magnet, advancing the switch to position 3. In position 3, all the counting relays release. The release of the FO' relay advances the R-4 switch to position 4, from ground through its break contact, outer cam B, to battery through the R-4 magnet.

FINAL TENS SELECTION

26. In position 4, tens group 9 is selected in a manner similar to final brush selection. With the R-4 switch in position 4, a circuit is closed from ground through the inner contacts of cam S, make contact of the STP relay, lower inner and upper outer contacts of cam R, lower inner and upper outer contacts of cam Q, break contact of the 9' counting relay, winding of 9 counting relay, to battery through cam T, operating the 9 counting relay. When the first pulse is transmitted by the B commutator brush and segment in the final selector circuit, the 9' counting relay operates and transfers the pulsing circuit to the winding of the 8 counting relay. With each successive impulse, a pair of counting relays operate and lock. When the STP relay releases on the tenth impulse both the BO' and FO' relays operate in parallel and in series with the SO relay, and lock to ground through the make contact and armature of the O relay. The operation of the BO' relay opens the fundamental circuit thus stopping the upward movement of the final selector. The operation of the FO' relay advances the R-4 switch to position 5. As the switch advances out of position 4-1/4, all the counting relays and the FO' and BO' relays release. The release of the FO' relay advances the switch to position 6.

FINAL UNIT SELECTION

27. The final selector makes unit selection in a manner similar to final tens selection while the testing circuit waits in position 6 of the R-4 switch. When unit selection, 7 or 9, depending upon the position of the R-3 switch, is made, the FO' and BO' relays operate, advancing the switch to position 7. As the switch advances out of position 6-1/4, the counting relays release. The release of the FO' relay advances the B-63 switch to position 8.

28. When testing Kansas City type final selectors, "W" wiring is used. In position 8 of the R-4 (D-75493) switch, a circuit is closed from battery through one winding of the line relay in the final selector circuit over the tip side of the final circuit, TT-1 lead, cam F (R-1A), make contacts of the TR and VT relays, 18 BK resistance, lower inner and upper outer contacts of cam K, break contact of the W relay, break contact of the BO' relay to ground through the winding of the STP relay, which operates. The STP relay operated, closes a circuit from ground through the inner contacts of cam S, make contact of the STP relay, lower inner and upper outer contacts of cam R, inner contacts of cam J, winding of the O relay, to battery on cam T, operating the O relay. The O relay operated connects its winding in series with the windings in parallel of the FO' and BO' relays which however, do not operate at this time. When the final selector advances, the STP relay releases, removing ground from one side of the BO' and FO' relays, allowing them to operate. The BO' relay operated, closes a circuit from ground through its make contact, cam B to battery through the R-4 (D-75493) switch, advancing the switch to position 9.

29. When testing a final selector circuit that does not depend upon a sender to advance it from the awaiting sender position, "Z" wiring is used. In position 8, a circuit is closed from ground through cam D to battery through the R-4 (B-63) magnet, advancing the switch to position 9. The R-4 (B-63) switch awaits in position 9 until the test of the final circuit has been completed.

30. As explained under "General Description", the type of test (one of seven) made upon the final selector circuit depends upon the position of the R-3 sequence switch, if the MT key is not operated. When the MT key is operated, these seven tests are made automatically and consecutively upon the final selector circuit.

MULTI TEST OF FINAL SELECTOR CIRCUIT

31. The operation of the MT key closes a circuit advancing the R-3 switch from position 1 upon the completion of the first test on the final selector circuit, as hereinafter described.

TEST NO. 1 INDIVIDUAL LINE IDLE

32. With the R-3 switch in position 1 and the R-4 switch in position 9, the terminals of the final selector are resting on the terminals of line 99. NOTE: The terminals of three test lines are represented in the time alarm portion of the test circuit.

32.1 When the brushes of the final selector rest upon the terminals of line 99 the SUB relay, which represents the called subscriber, is bridged across the T and R terminals of the test line. With the final sequence switch in the talking position the SUB relay operates in a circuit from ground through the lower inner contacts of cams F and E (R-4) make contact of the VT and TR relays, lower contacts of cam F (R-1A) over the TT-1 lead, T brush and terminal of the final selector, break and make contacts of the TRA key inner contacts of cam I (R-3) winding of the SUB relay, 18-CF resistance, outer contacts of cam V (R-4), inner contacts of cam J (R-3), make and break contacts of the TRA key, R terminal and brush of the final selector, TR-1 lead, lower contacts of cam E (R-1A), make contact of TR relay, lower contacts of cam I (R-4), inner contacts of cam H (R-3) to battery through the break contact of the TKR relay and 18-BH resistance, (W wiring), operating the SUB relay. The operation of the SUB relay closes a circuit from ground through its make contact, lower inner and upper outer contacts of cam O (R-3) to battery through the winding of the TKR relay which operates. The operation of the TKR relay represents the calling subscriber replacing the receiver on the switchhook.

32.2 When "Z" wiring is used, the SUB and TKR relays operate in series in the same circuit as just traced to cam H (R-3), then through the lower inner and upper outer contacts of cam O to battery on the winding of the TKR relay. The SLV relay operates from ground through its two windings in series, lower contacts of cam K (R-3), make and break contacts of the TRA key to battery on the sleeve of the final circuit.

32.3 The operation of the TKR relay closes a circuit from ground through its make contact, make contact of the SUB relay, winding of the MT relay to battery on cam T, operating the MT relay. Also the operation of the TKR relay opens the circuit from ground on cam G (R-2), over the TS-1 lead to the final selector, releasing a relay in the final selector circuit, thereby advancing the circuit from its talking position to its next position where it awaits the release of the SUB relay. The operation of the MT relay closes a circuit from ground through its make contact, cam C, to battery through the R-4 magnet, advancing the switch to position 10. From position 9 to 9-1/2, the TKR relay is held operated in a circuit from battery through the winding of the relay, outer contacts of cam O, make contact of the TKR relay, to ground on the make contact of the SLV relay. From position 9-3/4 to position 13 of the R-4 switch, the TKR relay is held operated from battery through the winding of the relay, upper contacts of cam O, make contact of the TKR relay, break contact of the MT relay, over the TS-1 lead to ground in the final circuit. When the R-4 switch advances out of position 9, the energizing circuit for the MT relay is opened, releasing the relay. The release of the MT relay, closes from ground through its break contact, lower contacts of cam U, cam C, to battery through the R-4 magnet, advancing the switch to position 11. With the switch in position 11, the MT relay re-operates over the same circuit as it previously operated, advancing the switch to position 12, in which position the MT relay again releases, advancing the switch to position 13. As the R-4 switch advances from position 12, the operating circuit of the SUB relay is opened at cam V (R-4), releasing the SUB relay. The Line relay in the final circuit releases through the 18-BA resistance which remains connected to the ring side of the final circuit and the sequence switch and elevator in the final circuit are restored to normal. In position 13, the MT relay re-operates

to ground on cam G and advances the R-4 switch to position 14. As the switch advances from position 13 the MT relay releases. As the switch enters position 13-1/2 the SUB relay is again connected across the tip and ring sides of the final circuit to ascertain whether the line relay in the final circuit has released. If the line relay in the final circuit has released through the 18-3A resistance, the SUB relay does not re-operate, and a circuit is closed from ground through the break contact of the MT relay, break contact of the SUB relay, upper outer and lower inner contacts of cam U (R-4) cam C, to battery through the R-4 magnet, advancing the switch to position 15. In position 15, the MT relay re-operates to ground on cam G, advancing the switch to position 16. If the line relay in an incoming circuit should not release through the 8000 ohm resistance, the SUB relay will re-operate in position 14 of the R-4 switch, preventing the sequence switch from advancing to position 15. The circuit will remain in this position until the operation of the time alarm circuit as hereinafter described.

32.4 In position 16 of the R-4 switch a circuit is closed from ground through the upper inner contact of cam E (R-4), break contact of the CA key, make contact of the MT key, cam B (R-3) to battery through the R-3 magnet, advancing the switch to position 2. In position 2 of the R-3 switch, a circuit is closed from ground through the lower contacts of cam C, upper contacts of cam L on the R-4 switch, cam B, to battery through the R-4 magnet, advancing the switch to position 17. The RS-3 relay also operates in position 16 over a circuit from battery through its winding, break contact of the MPB relay, break contacts of the REP relay, MT and CA keys, cam E to ground on cam F. The RS-3 relay operated, operates the RS-2 relay to ground on cam G. The RS-2 relay operated, operates the TF and TF-1 relays as already described under paragraph 20. The RS-2, RS-3, TF and TF-1 relays operated, function in connection with advancing the incoming selector to the next trunk of the group as hereinafter described under paragraph 42. The R-4 switch advances to position 1 from ground on the make contact of the ST key, through cam C, to battery through the R-4 magnet. As the R-4 switch is passing through positions 17 and 18, a circuit is closed from ground through the inner contacts of cam F (R-4), to battery through the winding of the 5-C (ST) register, which operates and records the number of single tests. In position 1 of the R-4 switch, a circuit is closed from ground through the upper outer contact of cam F (R-4) cam B (R-3), to battery through the R-3 magnet, advancing the switch to position 3.

TEST NO. 2 INDIVIDUAL LINE BUSY

33. With the R-3 switch in position 3, the final selector is re-directed to line 99, and the condition on the sleeve of the line is changed to battery through 220 ohms. This circuit is from battery through the 18-Q resistance, cam G, lower contacts of cam K, make and break contacts of the TRA key, S terminal and brush of the final elevator, causing the P.B.X. and busy test relays in the final to operate starting a sequence of events in the final circuit which advances the sequence switch to its busy back position. In this position, intermittent 24 volt battery or ground according to the type of final being tested is connected over the ring side of the final TR-1 lead, lower contacts of cam E (R-1A) make contact of TR relay, lower contacts of cam I (R-4) lower contacts of cam H (R-3) to ground or battery, as the case may be, through the winding of the

BB relay, which operates and releases in unison. The R-4 switch was advanced to position 9 as previously described. The BB relay operated, closed a circuit from ground through its make contact, break contact of the 1' counting relay, winding of the 1 counting relay to battery on cam T, operating the 1 counting relay. The 1 counting relay operated, connects its winding in series with the winding of the 1' counting relay. Upon the release of the BB relay, ground is removed from one side of the 1' counting relay, allowing it to operate to ground on the make contact of the 1 counting relay. The operation of the 1' counting relay, transfers the pulsing circuit through its make contact to the winding of the 0 counting relay. Upon the next operation of the BB relay, the 0 relay operates and connects its winding in series with the windings of the FO' and BO' relays connected in parallel. Both the FO' and BO' relays operate and lock to ground through the make contact of the 0 relay. The operation of the BO' relay performs no useful function. The operation of the FO' relay closes a circuit from ground through its make contact, cam B to battery through the R-4 magnet, advancing the switch to position 10. As the switch advances out of position 9 the busy back circuit through the winding of the BB relay is opened at cam I. In position 10, a circuit is closed from ground through the upper outer contact of cam C on A-57, outer contacts of cam J (R-4) to battery through the winding of the BB-1 relay which operates and locks through its make contact to ground on cam G. The operation of the BB-1 relay closes a circuit from ground through the lower outer contact of cam G (R-4), make contact of the BB-1 relay, to battery through the winding of the TKR relay, which operates, thereby releasing a relay in the final circuit, restoring it to normal. The operation of the BB-1 relay also closes a circuit from ground through its make contact, cam C, to battery through the R-4 magnet, advancing the switch to position 16. In position 16, a circuit is closed from ground through the upper inner contact of cam E, break contact of the CA key, make contact of the MT key, cam B (R-3) to battery through the R-3 magnet, advancing the switch to position 4. In position 4, a circuit is closed from ground to the lower outer contact of cam C, upper contacts of cam L (R-4) cam B, to battery through the R-4 magnet, advancing the switch to position 17. The switch is advanced to position 1 by ground on the make contact of the ST key. The 5-C register (ST) again operates as the switch is passing through position 17 and 18 recording another single test. With the R-4 switch in position 1, the R-3 sequence which is advanced to position 5 from ground on cam F.

TEST NO. 3

P.B.X. Line Idle (first of group)

34. With the 457 switch in position 5 the final is again directed to line 99 and test No. 1 is repeated except that the condition imposed on the sleeve is such that it represents an idle condition of the first line of a P.B.X. group. The sleeve terminal of the final is now grounded through the 100 ohm winding of the SLV relay instead of through its windings in series and the relay therefore operates through its 100 ohm winding. At the successful conclusion of this test, the R-3 sequence switch advances to position 7 in the same manner as it advanced to position 5, and the R-4 switch is restored to normal in the same manner as described in test No. 1.

TEST NO. 4

Hunt Idle P.B.X. Line (Last of group).

35. With switch R-3 in position 7, the final selector is directed to line 97 where it finds battery through 2600 ohms connected to the S terminal. The busy test relay in the final circuit operates but the P.B.X. relay does not operate owing to the high sleeve resistance and the final selector goes trunk hunting. The final selector passes by terminal 98 and reaches terminal 99, which represent an idle trunk to a P.B.X. station. From this point, the test proceeds as explained under test No. 1. If the test on the final is successful, the R-3 switch advances to position 9 and the R-4 switch to position 1.

TEST NO. 5

Hunt Busy P.B.X. Line (Last of group).

36. In position 9, the final is redirected to line 97, the sleeve condition on line causing the busy test relay in the final circuit to operate. When the elevator reaches line 99, it still finds a busy condition on the sleeve operating the P.B.X. relay in the final, advancing the final to its busy position. From this point, the test circuit functions in the same manner as described for test No. 2. If the test is successful the R-3 sequence switch advances to position 11 and the R-4 switch to position 1.

TEST NO. 6

Hunt Idle P.B.X. Line (Intermediate).

37. In position 11 of the R-3 sequence switch, the final selector is redirected to line 97, the sleeve condition of which represents a busy P.B.X. trunk. The selector continues to move upwards until terminals 99 are reached, which represent an idle P.B.X. trunk intermediate in the group. The test now proceeds as described for test No. 1. Upon the successful completion of this test, the R-3 switch advances to position 13 and the R-4 switch to position 1.

TEST NO. 7

"No Test Feature".

38. In position 13 of the R-3 sequence switch the final selector is redirected to line 99 and battery is connected to the S terminal through a low resistance (220 ohms), cam G (R-3) and lower contacts of cam K, causing the line to test busy. The final, however, does not restore to normal, for as the R-4 switch is advancing from position 6 to position 8, battery is connected through 200 ohms resistance, lower contacts of cam L (R-3) inner contacts of cam I (R-4) make contact of the TR relay, cam E, TRI lead, to the ring side of the final, operating the P.B.X. relay in the final. The operation of this relay prior to making the busy test advances the final sequence switch to its talking position. In position 13 of the R-3 switch, the holding circuit of the VT relay is transferred, from the outer contacts of cam L, to ground on cam D. When "W" wiring

is used, the W relay (E1057) operates to ground on cam C (R-3) closing a circuit from ground through its make contact, upper outer contact of cam D (R-4) to battery through the R-4 magnet, advancing the switch to position 9. When "Z" wiring is used, ground on the upper outer contact of cam D advances the R-4 switch to position 9. Also the operation of the W relay opens the circuit from ground through the winding of the STP relay, to the tip side of the final, thereby preventing the prior operation of the MT relay. The W relay releases when the A-57 switch advances out of position 13.

38.1 When the R-4 switch enters position 9, the MT relay operates over a circuit from ground through the lower inner contact of cam E (R-4) make contacts of the VT and TR relays, cam F, over the TP-1 lead, tip side of the final selector, T brush and terminal of line 99, break and make contacts of the TRA key, lower contacts of cam I (R-3) to battery through the winding of the MT relay. The MT relay operated, locks through its make contact to ground on cam C (R-3). The operation of the MT relay opens the locking circuit of a relay in the final selector, restoring the final circuit to normal. The operation of the MT relay also closes circuit from ground through the make contact of the MT key, cam F, to battery through the R-3 magnet, advancing the switch to position 14.

38.2 In position 14, a circuit is closed from ground through the upper outer contact of cam D (R-4) to battery through the R-4 magnet, advancing the switch to position 16. In position 16, a circuit is closed from ground through the upper inner contact of cam E (R-4) break contact of the CA key, make contact of the MT key, cam B, to battery through the R-3 magnet, advancing the switch to position 18.

39. In position 18 of the R-3 switch a circuit is closed from ground through the lower outer contact of cam D make contact of the MT key, break contact of the REP relay, break contact of the MTB relay, to battery through the winding of the RS-3 relay, which operates and locks to ground on its own armature.

40. The operation of the RS-3 relay closes a circuit from ground through its make contact, cam B (R-4) to battery through the R-4 magnet, advancing the switch to position 17. The switch advances to position 1 over a circuit from ground through the make contact of the ST key, lower inner contact of cam C to battery through the R-4 magnet. As the switch passes through positions 17 and 18 a circuit is closed from ground through the inner contacts of cam F to battery through the winding of the 5-C message register (ST) which operates. With the R-4 switch in position 1, a circuit is closed from ground through the upper outer contact of cam F, cam B, to battery through the R-3 magnet, restoring the switch to normal. The operation of the RS-3 relay closes a circuit from battery through the winding of the RS-2 relay, make contact of the RS-3 relay, to ground on cam G, operating the RS-2 relay.

SINGLE TEST ON FINAL CIRCUIT

41. When the MT key is not operated the type of test made on the final circuit depends upon the position of the R-3 switch which may be set by hand for any test. The test circuit functions for any particular type of test the same

as described for that type of test under "Multi-Test of Final Circuit," until position 16 of the R-4 switch is reached.

42. In position 16, the RS-3 relay operates in a circuit from battery through the winding of the relay, break contacts of the MPB and REP relays, break contacts of the MT and C4 keys, to ground on cam E (R-4). The RS-3 relay operated, closes a circuit from ground through its make contact, cam B, to battery through the R-4 magnet, advancing the switch to position 17. The R-4 switch is advanced to position 1 (normal) from ground on the ST key.

ADVANCING INCOMING SELECTOR

43. In order to test the next trunk in the incoming group, the incoming elevator must step up one terminal. The R-4 switch in position 1 closes a circuit from ground through the make contact of the RS-3 relay, lower contacts of cam L (R-4), break contact of the RS-1 relay, to battery through the inner winding of the RS relay and the outer winding of the RS-1 relay, operating the RS relay. The RS-1 relay does not receive sufficient current to operate at this time. The operation of the RS relay closes a circuit from ground through the make contact of the relay, upper outer and lower inner contacts of cam Q (R-2) make contact of the RS-2 relay, inner contacts of cam D (R-2), lower contact of cam J (R-1A), TU-1 lead, to battery through the UP magnet in the incoming circuit, causing the elevator to move upward. As the incoming elevator moves upward, ground supplied through the C commutator brush and segment over lead TC-1, lower contacts of cam K (R-1A) lower contacts of cam I (R-2), make contact of the RS relay to battery through the inner winding of the RS-1 relay, operates the RS-1 relay, and holds the RS relay operated through its outer winding.

44. When the C commutator brush connects to an insulated segment of the C commutator, ground is removed from the TC-1 lead, releasing the RS relay thus stopping the upward movement of the incoming selector. The RS-1 relay does not release, having locked from battery through its outer winding and make lower contacts of cam L (R-4) to ground on the armature of the RS-3 relay. The release of the RS relay closes a circuit from ground through its break contact, make contact of the RS-1 relay, make contact of the RS-3 relay, to battery through the winding of the RS-4 relay operating the RS-4 relay. The operation of the RS-4 relay, opens the locking circuit of the RS-3 relay, which releases. The release of the RS-3 relay, in turn releases the RS-2 and RS-1 relays. The release of the RS-2 relay opens the circuit through the 1000 ohm winding of the TF relay, but the relay does not release if the final is busy. If the final circuit is busy, ground is supplied over the TS-1 lead, to battery through the 800 ohm winding of the TF relay. The function of the TF relay and TF-1 relay is the same as described under paragraph 23. The routine test of the second final trunk in the group proceeds exactly like the first trunk in the group if the position of MT key is unchanged. Upon the completion of the single or seven tests the incoming elevator advances to the next trunk in the group. This procedure is repeated until the overflow terminals of the first group are reached by the incoming elevator.

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OVERFLOW PASS BY

45. As it is necessary to test the final trunks in the remaining groups of the incoming frame, the incoming elevator must pass by the overflow terminal to the first trunk in the next group. With the incoming elevator brushes resting upon the overflow terminals, a circuit is closed from ground through the Z commutator segment and brush, over lead TA-1, lower contacts of cam M (R-1A), brush 4 and terminal 1 of the IC switch, outer contacts of cam P (R-2) to battery through the winding of the ZC relay, which operates. The operation of the ZC relay closes a circuit from ground through its make contact, terminal 1 and brush 3 of the IC switch, outer contacts of cam O, break contact and winding of the 200-L selector switch magnet to battery through the 44-A resistance operating the magnet, which moves the brush assembly of the IC switch to terminal 2. With the IC brush assembly on terminal 2, the operating circuit of the Z relay is opened, releasing the ZC relay, which closes a circuit from ground through its break contact, outer contacts of cam L, brush 1 and terminal 2 of the IC switch, break contact of the MPB key, break contact of the MPB relay, to battery through the winding of the RS-3 relay which operates. The TF-1 relay does not release with the operation of the RS-3 relay, being held operated in a circuit to ground through terminal 2 and brush 6 of the IC switch. The RS-3 relay operated, locks through its make contact, break contact of the RS-4 relay, terminal 2 and brush 5 of the IC switch, to ground on the break contact of the ZC relay. The operation of the RS-3 relay in turn operates the RS-2 relay, over a circuit to ground on cam G (R-2) and closes a circuit operating the RS relay to ground on its armature. The operation of the RS and RS-2 relays operates the UP magnet of the incoming selector circuit, moving the incoming elevator to the first terminal of the next group in the same manner as the elevator was moved from one terminal to another terminal in the same group. Upon the operation of the RS-1 relay and release of the RS relay, as previously described, the RS-4 relay operates, closing a circuit from ground through its make contact, break contact of the Z relay, terminal 2 and brush 3 of the IC switch, outer contacts of cam O, to battery through the break contact and winding of the 200-L selector magnet, and 44-A resistance moving the brush assembly of the IC switch to terminal 3.

46. All the trunks in the second group are tested in the same manner as the first trunk in the first group, and when the incoming elevator brushes rest upon the overflow terminals of the second group, the elevator is moved to the first terminals of the third group in the same manner as just described. At this time, the IC brush assembly is resting on terminal 5. This procedure is repeated until all the trunks in the four consecutive groups have been tested. The brushes of the incoming elevator are then resting upon the overflow terminals of group 4 and the IC brush assembly is resting on terminal 7.

INCOMING ELEVATOR RETURNED TO NORMAL

47. With the IC switch on terminal 7, the Z relay operates from ground on the Z commutatator segment over the TA-1 lead and advances the IC brushes to terminal 8. With the IC switch on terminal 8, the Z relay is released, closing a circuit from ground through its break contact, outer contacts of cam L, brush 1 and terminal 8 of the IC switch, to battery through the R-1B magnet,

which advances the sequence switch to position 8. In position 8, a circuit is closed from ground on cam F, lower contacts of cam H (R-1A) over the TD-1 lead, to battery through the DOWN magnet in the selector circuit, operating the magnet and restoring the incoming elevator to normal. When the incoming elevator reaches the bottom of the frame, a circuit is closed from ground through the Y commutator brush and segment over the TY-1 lead, lower contacts of cam G (R-1A) cam C (R-2) to battery through the R-2 magnet, advancing the switch to position 9. When the R-2 switch is passing through position 8-3/4 to 9, a circuit is closed from ground through the contacts of the ST key, outer contacts of cam S (R-2), break contact of the TRA relay, to battery through the winding of the 200-M (I-A) selector magnet, operating and releasing the magnet, moving the I-A switch to the next terminal. With the R-2 switch in position 9, a circuit is closed from ground through the break contact of the Z relay, outer contacts of cam L, brush 1 and terminal 8 of the IC switch, to battery through the R-2 magnet, advancing the switch to position 10 (normal). Also in position 9 a circuit is closed from ground through the lower outer contact of cam G, terminal 8 and brush 3 of the IC switch, outer contacts of cam O, break contact and winding of the 200-L selector magnet and 44-A resistance to battery, stepping the IC switch to terminal 9, where the circuit through the 200-L selector magnet is re-established through terminal 9 and brush 3 of the IC switch, stepping the IC switch to terminal 12 or normal. With the R-2 switch in position 10, a circuit is closed from ground through the lower inner contact of cam G, and cam D (R-4) to battery through the R-4 magnet, providing an additional means of returning the R-4 switch to normal.

48. If the terminal upon which the brush assembly of the I-A switch rests is wired for a test, the circuit functions as described for the first terminal of the I-A switch, until all the groups as determined by the cross connection scheme for this terminal have been tested, whereupon the 200-M magnet is again energized, moving the brush assembly of the I-A switch to the next terminal. When all the final selector circuits available to the first incoming elevator have been tested, the R-IA switch advances from position 3 to position 4, in which position a second incoming elevator is tested to determine whether it is being used in regular service.

SELECTION OF SECOND INCOMING ELEVATOR

49. Assuming that the second incoming elevator must be used when the brush assembly of the I-A switch rests upon terminal 6, a circuit is closed from ground on the make contact of the CON relay, break contact of the EC key brush 6 and terminal 6 of the I-A switch, cross connection of terminal strip 6, lower outer contact of cam B (R-IA) to battery through the R-I-A magnet, advancing the switch to position 4. As the switch enters position 3-1/4 the PG relay operates over a circuit from ground through the upper outer and lower inner contacts of cam A, winding of the PG relay, lower inner and upper outer contacts of cam S to battery. The operation of the PG relay removes ground from the TK-1 lead, thereby permitting the immediate use of the associated incoming selector, when necessary, in regular traffic. In position 4, the second incoming selector circuit is tested in a manner similar to the first incoming selector circuit, for a busy condition, except that lead TK-2 is used instead of TK-1. When the incoming selector circuit becomes idle, the (R-1A) switch advances to position 5. From this point the test circuit functions as described with the R-1A switch in position 3.

When all the groups of final selector circuits available to the second incoming elevator have been tested, the R-1A switch advances to position 6 where it tests a third incoming selector circuit for a busy condition, using lead TK-3. Assuming that a third incoming elevator must be used when the brush assembly of the I-A switch rests on terminal 10, a circuit is closed from ground through the make contact of the CON. relay, break contact of the EC key, brush 6 and terminal 10 of the I-A switch, cross connection of terminal strip 6, upper outer contact of cam B (R-IA) to battery through the R-IA magnet, advancing the switch to position 6. The switch is advanced to position 7 and connected to the third incoming elevator in the same as it was connected to the first incoming elevator.

50. The test of the final selector trunks in the groups available to the third incoming elevator proceeds in the same manner as described for the first incoming elevator. If all the final selector circuits have not been tested with the use of three incoming elevators, a fourth or more incoming elevators must be used, thus necessitating the addition of a connector for every one to three additional incoming selectors required. Assuming that the fourth incoming elevator is required when the brush assembly of the I-A switch rests on terminal 15, a circuit is closed from ground on make contact of the CON. relay, break contact of the EC key, brush 6 and terminal 15 of the I-A switch, cross connection of terminal strip 6, over lead 4, lower inner and upper outer contacts of cam P (R-IA), cam C, to battery through the R-I-A magnet, advancing the switch to position 8. The A cam advances the switch to position 10. In position 10, the same ground on the CON relay, through the lower contacts of cam P, and lower inner contact of cam B R-IB advances the R-IB switch to position 2. In position 2, the fourth selector circuit is tested for a busy condition over lead TK-4. From this point on, the test circuit functions as described for the first incoming elevator.

51. If all the final selector circuits have not been tested by the time the I-A selector switch completes one revolution, a second switch, I-B, is required. When the brush assembly of the I-A switch rests upon terminal 21 a circuit is closed from ground through the make contact of the CON. relay, break contact of the EC key, brush 6 and terminal 21 of the I-A switch, to battery through the winding of the TRA relay, which operates. The TRA relay operated; (a) closes a circuit from ground through the armature and make contact of the CON relay, make contact of the TRA relay, over the BG-1 lead, to battery through the winding of the RN relay which operates, (b) closes a circuit from ground through its make contact, N terminal and brush 1 of the I-B switch, terminal 21 and brush 1 of the I-A switch, make contact of the TRA relay, to battery through the break contact and winding of the 200-M (I-B) selector magnet, moving the brush assembly of the I-B switch to terminal 1. From this point the automatic test of the final selector circuits associated with this I switch unit is completed in a similar manner as described for the first I switch unit. When the brushes of the I-B switch rest on terminal 21, and there are more final selector circuits to be tested, a third switch (I-C not shown) is required. This switch is moved off normal in exactly the same manner as the I-B switch was stepped to terminal 1.

CONCLUSION OF A ROUTINE TEST

52. After a test has been made upon all of the final selector circuits, ground is connected through the make contacts in parallel of both the CON. and RN relays, break contact of the EC key, brush 6 and terminal 21 of the last I switch unit in the equipment, to battery through the EC lamp which lights. This signal lamp indicates that the end of a complete routine test has been reached; and if another cycle is not desired, the RN key is depressed, and the ST key released. The operation of the RN key closes a circuit from ground through its make contact, to battery through the winding of the RN-1 relay which operates and locks through its make contact to ground on the make contact of the RN relay. The release of the ST key opens the holding circuits of the CON. and ST relays, releasing the relays. The release of the CON relay extinguishes the EC lamp and releases the TRA relay. The release of the TRA relay in turn releases the RN relay, but the RN-1 relay does not release being held also in a circuit from ground through the break contact of the PC key, brush 4 and terminal 21 of the I-A switch, make contact of the RN-1 relay, to battery through its winding. Also the release of the TRA relay closes a circuit from ground through the contacts of the PC key, brush 4 and terminal 21 of the I-B switch, break contact of the TRA relay, to battery through the break contact and winding of the 200-M (I-B) selector magnet, stepping the brush assembly of the I-B switch to the next or normal terminal. The RN key is now released, closing a circuit from ground through the break contact of the key, make contact of the RN-1 relay, terminal 21 and brush 4 of the I-A switch, break contact of the TRA relay, to battery through the break contact and winding of the 200-M (I-A) selector switch, moving the I-A switch to its normal terminal. With the I-A switch in its normal position, the holding circuit of the RN-1 relay through terminal 21 and brush 4 of the I-A switch to ground on the PC key is opened, releasing the relay. This completes a single routine test of all final selector circuits in a full mechanical exchange.

TEST OF A PARTICULAR FINAL GROUP

53. In order to enable the test man to make a test upon a particular group of final selector circuits, or a particular final circuit, a chart is provided showing the groups of final trunks available to a brush on an incoming frame; and also it shows what keys to operate in conjunction with the PC key to cause an I switch to step to a terminal which permits the test of a particular group of trunks.

54. Assume that the group to be tested is reached by an incoming selector associated with the I-B switch, and also requires the use of a third connector. Further assume that the cross connection scheme shown on the schematic applies to the I-B switch as well as the I-A switch. If it is desired to test a single group of trunks appearing in the 8th incoming frame, the following keys must be depressed. In the units row, key 7; in the second row, the tens (T) key and the TWB key; in the group number (GN) row, key 2; and in the overflow count (OC) row, key 1; after which the PC, the TRA, and the ST keys are depressed. With these keys depressed the brush assembly of the I-B switch will step to terminal 18, causing an elevator on the 8th incoming frame to test the first

trunk of group 2 in the bank 3 of the frame. This will necessitate the use of connector 3 (not shown), which however, is entirely similar to connector 2. For clearness, the 5 lead of the second connector will be used to represent the 8 lead of the third connector. After testing the 8th frame, the incoming elevator will return to normal upon stepping to the overflow terminals.

INCOMING SELECTION

55. The operation of the ST and TRA keys close a circuit operating the ST relay. The ST relay operated, closes a circuit from ground through the make contact of the TRA key, make contact of the ST relay, break contact of the EC key, break contacts of the TWD and TWC keys, make contact of the TWB key, over the CC-1 lead, to battery through the winding of the TRA relay, operating the relay. The operation of the TRA relay closes a circuit from ground through its make contact, N terminal and brush 1 of the I-B switch, over lead BA-1, make contact of the TWB key, break contacts of the TWC and TWD keys, N terminal and brush 1 of the I-A switch, make contact of the TRA relay, to battery through the break contact and winding of the 200-M selector (I-B) magnet stepping the brush assembly of the I-B switch to terminal 1. With the I-B switch on terminal 1, a circuit is closed from ground through the make contact of the PC key, normal contacts of units keys 0 to 6 inclusive, over leads 1 to 7, through the 1 to 7 contacts and brush 1 of the I-B switch, lead BA-1, make contact of the TWB key, break contacts of the TWC and TWD keys, normal contact and brush 1 of the I-A switch, make contact of the TRA relay, to battery through the break contact and winding of the 200-M (I-B) magnet, moving the brush assembly of the I-B switch to position 8. The tens (T) key operated, closes a path permitting an I switch to step by the units terminal associated with the operated U key and to proceed to the tens terminal associated with the U key. With the I-B switch resting on terminal 8, the energizing circuit for the 200-M (I-B) magnet is from ground through the make contact of the PC key, T key, make contact of units key 7, over lead 8, terminal 8 and brush 1 of the I-B switch, contacts of the the TWD, TWC and TWB keys, make contact of the TRA relay, to battery through the break contact and winding of the 200-M (I-B) magnet, moving the I-B switch to terminal 9. Terminals 9 to 17, inclusive, of the I-B switch are connected over leads 9 to 17, inclusive, to ground through the associated units keys, thereby stepping the brush assembly of the I-B switch to terminal 18. When the I-B switch steps to position 18, the energizing circuit of the I-B magnet over lead 18 is opened at the contacts of units key 7, stopping the movement of the I-B switch. The removal of ground from the terminal 18 of the I-B switch, allows the T relay to operate in a circuit from ground through the make contacts of the ST relay, lower contacts of cam J, to battery through the windings of the T relay and 200-M (I-B) magnet, operating the T relay. The I-B magnet does not operate in series with the high resistance of the T relay. The T relay operated, in turn operates the CON relay.

56. With the I switch resting on terminal 18 a circuit is also closed from ground through the make contact of the CON. relay, brush 6 and terminal 18 of the I-B switch, cross connection of terminal strip 6, over a lead (not shown), and lower outer contact of cam B on the third connector switch to battery through the R-IC magnet, (not shown), advancing the third connector to position 4. Having

assumed that connector 2 and the 5 lead represents connector 3 and the T-8 lead, the circuit operating the third connector magnet may be traced visually over lead 5 from terminal strip 6, and cam B, to battery through the R-IB magnet. With the connector in position 4, the incoming selector circuit assigned for test purposes is tested for a busy condition. When the incoming selector circuit becomes idle, or if it is idle, the connector switch moves to position 5, in which position this circuit is connected to the incoming elevator. The test circuit waits in this position until the PC key is released.

INCOMING BRUSH AND GROUP SELECTIONS

57. Sequence switch R-2 advances to position 2 and then to position 4 in the same manner as described under "Routine Test". In position 4, the incoming elevator is moved upward for incoming brush selection, selecting brush 3. Upon receipt of the fourth pulse transmitted by the A commutator brush and segment in the incoming, the R-2 switch advances to position 5, and then to position 6 in the same manner as described under "Routine Test". In position 6, the incoming elevator moves up for group selection. Intermittent ground is connected over the TB lead, through the upper outer and lower inner contacts of cam L on the connector, upper contacts of cam M (R-2), break contacts of the GN key 3, make contact of the GN key 2, break contact of counting relay 2', to battery on cam R through cam N and the winding of counting relay 2, operating the relay. When ground is removed from the TB lead, relay 2' operates and locks through the make contact of counting relay 2. Upon receipt of the second pulse, counting relay 1' operates and locks to ground through the make contact of counting relay 1. The operation of counting relay 1' transfers the pulsing circuit from the SO, and BO' and FO' relays, to the O and O' relays through cam M (R-4). The circuit for the third pulse is through the make contact of counting relay 1', lower inner and upper outer contacts of cam M, winding of the O relay, to battery on cam R, operating the O relay. When the circuit through the B brush on the incoming elevator is opened the O' relay operates and locks to ground on the make contact of the O relay. The operation of the O' relay advances the R-2 switch to position 7, over a circuit from ground through the make contact of the O' relay, break contact of the PC key, cam B to battery through the R-2 magnet.

SETTING INCOMING CONTROL SWITCH

58. When the R-2 switch enters position 3, the IC switch is stepped according to the OC key operated. A circuit then is closed from ground through the upper inner contact of cam E, break contact and winding of the 200-L selector magnet, to battery through the 44-A resistance, successively operating the selector magnet until it is shunted by ground over one of the leads to arc 2 of the IC switch. Having operated OC key 1, the IC switch steps until terminal 7 is reached; ground through the make contact of the OC key 1, over lead 1, terminal 7 and brush 2 of the IC switch, inner contacts of cam O, to battery through the 44-A resistance, shunts the winding of the magnet, thereby preventing its operation. When the R-2 switch advances out of position 6-1/4, ground is removed from both sides of the stepping magnet.

59. In position 7, the test on the particular line or group of final trunks proceeds in the same manner as described under "Routine Test" until the incoming elevator is stepped to the overflow terminal. Ground is then connected to the TA lead, brush 4 and terminal 7 of the IC switch, outer contacts of cam P, to battery through the Z relay, operating the relay. Also in position 7, a circuit is closed from battery on the upper inner contact of cam R make contact of the 149-G interrupter, to ground through the windings of the key release magnets releasing the U, GN, and OC keys. The operation of the Z relay advances the IC switch to terminal 8 as described under paragraph 47. From this point, the incoming elevator, the IC switch, and R-2 switch are restored to normal as also described under paragraph 47. As switch R-2 passes through positions 8-3/4 to 9, a circuit is closed through cam S, advancing the I-B switch to terminal 19. The circuit is restored to normal by operating the RN key and releasing the ST and TRA keys. The operation of the RN key operates the RN-1 relay. The release of the ST key closes a circuit from ground through the contacts of the key, outer contacts of cam T on B-62 cam B, to battery through the R-IC magnet (not shown) of the third connector, advancing the switch to position 8, the A cam carrying it to position 10 (normal). The operation of the RN key connects ground through the upper inner contact of cam H (R-2), break contact of the ST key, make contact of the RN key and normal contacts of the U keys, to all leads connected to arc 1 of the I-B switch, advancing the switch to terminal 21. With the I-B switch on terminal 21, the RN key is released, closing a circuit from ground through the break contact and winding of the release magnet associated with the T and TWB keys, make contact of the RN-1 relay, to battery through the break contact of the RN key, operating the magnet and releasing the T and TWB keys. The release of the TWB key opens the holding circuit for the TRA relay which releases. The release of the TRA relay closes a circuit from ground through the break contact of the PC key brush 4 and terminal 21 of the I-B switch, break contact of the TRA relay to battery through the break contact and winding of the 200-M stepping magnet, advancing the I-B switch to normal. The release of the TRA relay opens the holding circuit of the RN relay which releases. The release of the RN key and of the RN relay opens the holding circuit for the RN-1 relay which releases, restoring the entire circuit to normal.

TIMING FEATURE

60. Whenever the ST key is operated, a circuit is closed from ground through the make contact of the key, over lead A, terminal 1 and brush 4 of the time alarm switch, to battery through the winding of the TA relay, operating the relay. The TA relay operated, locks through its make contact and break contact of the TA key, over lead B, upper inner and lower outer contacts of cam H (R-4), to ground through the make contact of the ST key until position 2 of the R-4 switch, when the locking circuit is to ground through the upper contacts of cam H. Should trouble develop in the test circuit before switch R-2 reaches position 7, or should an incoming selector be kept busy in regular traffic for a time sufficiently long to prevent testing a final selector circuit completely before the TA switch makes one revolution, or should a final circuit show trouble under test, a circuit is closed operating a message register and lighting an alarm lamp. The operation of the TA relay also closes a circuit from ground through the contacts of a 152 type interrupter, make contact of the

TA relay, break contact of the Z relay (Y wiring used), to battery through the winding of the W relay and 450 ohm winding of the Z relay in series, operating the W relay. At the break of the interrupter contacts, the 190 ohm winding of the Z relay is connected in series aiding with the 450 ohm winding of the relay, through the winding of the W relay, operating the Z relay through the make contact of the W relay, upper contacts of cam H (R-4) to ground. At the next make of the interrupter contacts the winding of the W relay and 190 ohm of the Z relay are shunted by ground, releasing the W relay. The Z relay is held operated from ground through the contacts of the interrupter, make contact of the TA relay, make contact of the Z relay, to battery through the 450 ohm winding. A circuit is now closed from ground through the contacts of the interrupter, make contact of the TA relay, make contact of the Z relay, terminal 1 and brush 3 of the TA switch, to battery through the winding of the 200-R (MM) magnet, operating the magnet. At the second break of the interrupter, the holding circuit for the Z relay and the operating circuit of the MM magnet is opened, releasing the relay and magnet, moving the brushes of the TA switch to the next terminal. Upon the next, or third, make of the interrupter, the W relay re-operates repeating the above described cycle anew. If either the incoming elevator or the final selector circuit is kept busy on routine traffic sufficiently long to prevent the completion of the final tests in the time interval as determined by the Telephone Company, the TA switch advances to terminal 21. With the brush assembly of the switch resting on terminal 21, a circuit is closed from ground through the make contact of the TA relay, brush 2 and terminal 21 of the TA switch to battery through the alarm circuit, operating the alarm message register and lighting a signal lamp located in the test desk. The switch brushes remain on terminal 21 until the TA key is operated. The operation of the TA key releases the TA relay. The release of the TA relay closes a circuit from ground through its break contact, terminal 21 and brush 1 of the TA switch, to battery through the break contact and winding of the MM magnet, stepping the TA switch to normal. The TA relay re-operates with the TA switch normal, over the same circuit as it initially operated and locks through the contacts of the TA key, starting another timing interval. Should the test on a final selector circuit be completed before the TA switch completes a revolution, the holding circuit for the TA relay is opened when switch R-4 advances from position 18, releasing the TA relay. The release of the TA relay advances the TA switch to normal.

END OF CYCLE (EC) KEY

61. When one cycle of routine test has been completed upon all the final selector circuits, the EC lamp lights as previously described under paragraph 51. At this time all the sequence switches are normal, the brush assemblies of the I switches are resting on the last terminal of each unit, awaiting the operation of the RN key, the TRA, CON and RN relays are operated and the ST key depressed. If it is desired to start another cycle of routine tests, the EC key is operated momentarily. The operation of the EC key extinguishes the EC lamp and releases the TRA relay. The release of the TRA relay also closes a circuit from ground through the break contact of the PC key, brush A and terminal 21 of the I-B switch, break contact of the TRA relay, to ground through the break contacts and windings of the 200-M (I-B) magnet, which operates and moves the brush assembly of the I-B switch to normal. The circuit for

restoring the I-A switch is from ground through the make contact of the CON relay, make contact of the EC key, terminal 21 and brush 1 of the switch, break contact of the TRA relays, to battery through the break contact and winding of the 200-M (I-A) magnet. From this point another automatic test of all incoming selectors proceeds as described under "Routine Test".

CONTROL ADVANCE (CA) KEY

62. If trouble develops in either the test circuit itself, or in the final selector circuit under test, the time alarm lamp will light as described under "Timing Feature". If after the TA key is operated, the test circuit does not continue its functions, the CA key is operated. The operation of the CA key closes a circuit from ground, through the CA key, cam D, to battery through the R-4 magnet, advancing the switch to position 16. The circuit remains in position 16 as long as the CA key is operated. The final circuit during this interval is held busy from ground through cam E (R-2) break contact of the TF relay, upper contacts of cam P on B-63 break contacts of the TKR and NT relays, cam D, over the TS lead. After the release of the CA key, the circuit either advances the incoming elevator to the next final in the group, or repeats the test on the defective final, if the REP key is operated. If the REP key is not operated the RS-3 relay operates through the restored contact of the CA key to ground on cam E. From this point the R-4 switch is restored to normal as described under paragraph 40.

REPEAT (REP) KEY

63. When it is desired to repeat the test upon a certain final selector circuit, the REP key is operated. The operation of the REP key closes a circuit operating the REP relay, which locks to ground through the contact of the key as long as the key is operated, or through the make contact of the relay to ground on the lower outer contact of cam F (R-4), if the REP key is momentarily operated to make a single repeat test, or through the lower inner contact of cam D (R-3) if the MT key is operated. The operation of the REP relay closes a circuit from ground through cam E (R-4), break contacts of the CA and MT keys, make contact of the REP relay to battery through cam B and the R-4 magnet, advancing the switch to position 17. Ground on the ST key carries the switch to position 1. The RS-3 relay does not operate as described under "Routine Test" with the switch in position 16, due to the operating circuit for the RS-3 relay being opened at the contacts of the REP relay. In position 1, the second test upon the final selector circuit proceeds in exactly the same manner as the first test upon the circuit. This test is repeated until the release of the REP key which releases the REP relay, allowing the operation of the RS-3 relay at the conclusion of the test. From this point, the test circuit functions and steps the incoming elevator to the next set of final selector circuit terminals.

AUTOMATIC PASS BY (APB) KEY

64. Whenever a busy final selector is encountered the BF lamp lights to ground on the TS lead. The operation of the APB key causes the automatic test circuit to pass by all busy terminals and stop the incoming elevator upon the

first idle final selector terminals. The operation of the APB key removes the short circuit from around the winding of the PB relay allowing it to operate in series with the 800 ohm winding of the TF relay if the final selector circuit to be tested is busy. The operation of the PB relay closes a circuit from ground through the break contact of the RS-4 relay, make contact of the PB relay, break contact of the MPB relay, to battery through the winding of the RS-3 relay, operating the RS-3 relay. The RS-3 relay operated, operates the RS-2 relay to ground on cam G. The RS-3 relay operated, also operates the RS- relay which operates the UP magnat in the incoming circuit. From this point, the incoming elevator advances to the next terminal in the same manner as described under paragraphs 43 and 44. Should this final selector circuit also be busy, the cycle of operations just described is repeated until an idle final selector circuit is found. The RS-2 relay is made slow release to prevent the premature release of the TF relay when the momentum of the incoming selector momentarily carries its sleeve brush beyond the last of a series of busy terminals to an idle terminal. The premature release of the TF relay would release the PB relay, thus causing the selector to remain on the busy terminal.

65. Should the incoming elevator step to a set of overflow terminals with the APB key operated, the TF and PB relays release, and the Z relay advances the IC switch to an even numbered terminal, from which point it advances to the next odd numbered terminal as described under paragraph 45. If the first trunk in the next group is busy, the TF and PB relays re-operate, performing the same functions as described above. When the terminals of an idle selector circuit are found, the automatic test proceeds in the usual way, until the next busy terminal is found, which causes the PB relay to operate, unless meanwhile the APB key is restored to normal.

MANUAL PASS BY (MPB) KEY

66. When it is desired to move the incoming elevator from the terminals of a busy final selector circuit to the next set of final selector terminals which may or may not be busy, the MPB key is operated. The operation of the MPB key removes the shunt from around the winding of the PB relay, allowing it to operate in series with 800 ohm winding of the TF relay to ground over the TS lead. The operation of the PB relay operates the RS-3 and RS-2 relays as previously described in paragraph 64. The RS-2 relay operated, holds the TF relay operated through its 1000 ohm winding and closes a circuit from ground through its own make contact, make contact of the MPB key, to battery through the 800 ohm winding of the MPB relay, operating the MPB relay. The MPB relay operated, locks through its 1200 ohm winding and make contact to ground on the MPB key. The operation of the RS-3 relay causes the incoming elevator to move up to the next terminal as described in paragraph 43. The operation of the MPB relay prevents the re-operation of the RS-3 relay should the terminals test busy and operate the PB relay. When the MPB key is released, the automatic test proceeds if the final selector circuit is idle, or the test circuit waits until the final selector circuit becomes idle. The release of the MPB key releases the MPB relay. If it is desired to step by the second busy final selector circuit, the MPB key is re-operated, causing the circuit to function as just described and step the incoming elevator to the

next set of terminals. Should the operation of the MPB key step the incoming elevator from the last terminals of the group to the overflow terminals, the Z relay operates, moving the IC switch to the next even numbered terminal. The Z relay operated, locks through its make contact to ground on the make contact of the RS-4 relay. Upon the release of the RS-4 relay, the Z relay releases, advancing the IC switch to the odd terminal. From this point, the circuit functions as described under paragraph 45, advancing the incoming elevator to the first terminal of the next group. When the overflow terminal happens to be the last of the series of groups to be tested, the incoming elevator is returned to normal in the manner as described under paragraph 47. The test then proceeds on another incoming elevator which is used to continue the automatic test.

TO STOP AUTOMATIC TEST

67. The release of the ST and TRA keys release the ST relay, but the test circuit does not cease to function until the test being made at the time of the key release is completed. At the completion of the particular test the RS-3 relay operates and advances the R-4 switch out of position 16, ground on the break contact of the ST key, upper inner contact of cam D (R-4) advances the switch to position 18. The same ground advances the R-2 switch to position 8 through the lower inner contact of cam B. From this point on the incoming elevator and this circuit are restored to normal as described under paragraph 47.

CIRCUIT REQUIREMENTS

	OPERATE	NON-OPERATE	RELEASE
207-A (3TP)	Armature gap .013" to .014". Test .009 amp. Contact gap .003" to .004". Readj. .0092 amp. Test .010 amp. Readj. .0098 amp.		

MECHANICAL REQUIREMENTS

208-B prime counting relays 0' to 9' inclusive

(a) Armature gap .018 inch to .021 inch.
(b) Contact gap .004 inch to .005 inch.
(c) The retractile spring tension shall be adjusted by bending the stationary lug on the relay frame and not by bending the lug on the armature. In making this adjustment, the stationary lug shall not be bent to an angle greater than 45 degrees from the vertical.

ELECTRICAL REQUIREMENTS

Test .0152 amp.	Test .0138 amp.
Readj. .0148 amp.	Readj. .0142 amp.

MECHANICAL REQUIREMENTS

208-C (BO' and FO')

(a) Armature gap .018 inch to .021 inch.
(b) Contact gap .004 inch to .005 inch.
(c) The retractile spring tension shall be adjusted by bending the stationary lug on the relay frame and not by bending the lug on the armature. In making this adjustment, the stationary lug shall not be bent to an angle greater than 45 degrees from the vertical.

ELECTRICAL REQUIREMENTS

Through relay winding: Readj. .0118 amp. Through parallel combination: Test .0244 amp. Readj. .0236 amp.	Through relay winding: Readj. .0112 amp. Through parallel combination: Test .0216 amp. Readj. .0224 amp.

MECHANICAL REQUIREMENTS

208-G counting relays 0 to 9 inclusive and SO

(a) Armature gap .018 inch to .021 inch.
(b) Contact gap .004 inch to .005 inch.
(c) The retractile spring tension shall be adjusted by bending the stationary lug on the relay frame and not by bending the lug on the armature. In making this adjustment, the stationary lug shall not be bent to an angle greater than 45 degrees from the vertical.

CIRCUIT REQUIREMENTS

	OPERATE		NON-OPERATE		RELEASE	
ELECTRICAL REQUIREMENTS						
208-G (Cont'd)	Test	.0152 amp.	Test	.0138 amp.		
	Readj.	.0148 amp.	Readj.	.0142 amp.		
B36 (10)	Test	.033 amp.			Test	.003 amp.
	Readj.	.018 amp.			Readj.	.006 amp.
E380 (W)	Test	.027 amp.			Test	.0005 amp.
	Readj.	.009 amp.			Readj.	.001 amp.
E428 (Z)	Test	.019 amp.	Test	.0095 amp.		
	Readj.	.016 amp.	Readj.	.010 amp.		
E443 (SUB)	Test	.027 amp.			Test	.0076 amp.
	Readj.	.021 amp.			Readj.	.008 amp.
E458 (TF-1)	Test	.027 amp.			Test	.0008 amp.
	Readj.	.011 amp.			Readj.	.0015 amp.
E462 (BB)	Test	.010 amp.			Test	.0004 amp.
	Readj.	.007 amp.			Readj.	.0008 amp.
E502 (RN) (TR)	Test	.029 amp.			Test	.001 amp.
	Readj.	.014 amp.			Readj.	.002 amp.
E528 (RS-3)	Test	.032 amp.	Test	.010 amp.		
	Readj.	.023 amp.	Readj.	.011 amp.		
E530 (BB-1)	Test	.017 amp.			Test	.001 amp.
	Readj.	.013 amp.			Readj.	.002 amp.
E547 (TI) Outer Winding 400 ohms	Test	.007 amp.	Test	.029 amp.		
	Readj.	.046 amp.	Readj.	.031 amp.		
Inner Winding 900 ohms	Test	.025 amp.				
E573 (VT)	Test	.018 amp.			Test	.015 amp.
	Readj.	.014 amp.			Readj.	.003 amp.